

**HUGHES**

HUGHES AIRCRAFT COMPANY  
CULVER CITY CALIFORNIA

R and D Division

**TITLE**

PROCUREMENT SPECIFICATION  
SWITCH ASSEMBLIES,  
PUSHBUTTON, ILLUMINATED  
HAC C/N 252839

PS 31046-165  
NUMBER

CODE IDENT NO. 82577

SH 1 OF 19

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PROCUREMENT SPECIFICATION  
SWITCH ASSEMBLIES, PUSHBUTTON, ILLUMINATED  
HAC C/N 252839

1. SCOPE

1.1 Scope. This specification covers the requirements for illuminated pushbutton switch assemblies covered by Hughes Aircraft Company (HAC) control numbers (C/N) 252839-1 through 252839-22.

2. APPLICABLE DOCUMENTS

2.1 General. The following documents shall form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

L-P-410A-2                      dated 30 October 1967  
Plastic, Polyamide (Nylon),  
Rigid, Rods, Tubes, Flats,  
Molded and Cast Parts

ZZ-R-765-2                      dated 30 October 1967  
Rubber, Silicone, Low-and-  
High-Temperature and Tear  
Resistant

Military

MIL-M-14F-57                      dated 30 December 1965  
Molding Plastics and Molded  
Plastic Parts, Thermosetting

MIL-E-5400K                      dated 24 May 1968  
Electronic Equipment, Airborne.  
General Specification for

MIL-C-5541A                      dated 31 March 1964  
Chemical Films and Chemical  
Film Materials for Aluminum  
and Aluminum Alloys

MIL-A-8625C-1                      dated 13 March 1969  
Anodic-Coatings, for Aluminum  
and Aluminum Alloys

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MIL-M-20693A-5	dated 21 December 1966 Molding Plastic, Polyamide (Nylon), Rigid
MIL-F-21241 (NOrd)	dated 4 December 1958 Filters, Colors, Finished, For Optical Instruments
MIL-S-22885B-2 with Supplement 1C	dated 24 December 1968 Switch, Pushbutton, Illuminated, General Specification for

## STANDARDS

### Federal

FED-STD-3-1	dated 27 August 1951 Colors, Aeronautical Lighting
FED-STD-406	dated 5 October 1961 Plastics: Methods of Testing
FED-STD-595 Change Notice 2	dated 1 February 1961 Colors

### Military

MIL-STD-129D Change Notice 11	dated 4 April 1969 Marking for Shipment and Storage
MIL-STD-202C Change Notice 4	dated 20 January 1967 Test Methods for Electronic and Electrical Component Parts
MIL-STD-454	5 January 1965 Standard General Requirements For Electronic Equipment
MIL-STD-461A	1 August 68 Electromagnetic Interference Characteristics Requirements For Equipment
MIL-STD-462	31 July 67 Electromagnetic Interference Characteristics, Measurement Of
MS 24547D(ASG)	dated 14 May 1963 Switch, Sensitive - Sub- miniature

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2.1 (continued)

DRAWINGS

Hughes Aircraft Company

3111475

current issue  
Control Panel Nomenclature,  
AN/AWG-9

2.2 Precedence of documents. When the requirements of the contract, work authorization or purchase order, procurement specification, general specification, or applicable subsidiary specifications are in conflict, the following precedence shall apply:

- a. Contract - The contract, work authorization, or purchase order shall have precedence over any specification.
- b. Procurement specification - The procurement specification (PS 31046-165) shall have precedence over the general specification (MIL-S-22885).
- c. General specification - The general specification (MIL-S-22885) shall have precedence over all applicable subsidiary specifications.
- d. Referenced specifications - Any document referenced in this specification or in the general specification shall have precedence over all applicable documents referenced therein.

2.3 Updated documents. Newer releases of documents may be substituted for those referenced in 2.1 of this specification, but such substitutions shall require written approval of Hughes Aircraft Company.

2.4 Availability of documents. When requesting specifications, standards, drawings, and publications, refer to both title and number. Copies of applicable specifications required by contractors in connection with specific procurement functions may be obtained upon application to the Commanding Officer, Navy Supply Depot (Code CDS), 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120. Hughes Aircraft Company documents may be obtained upon application to the buyer.

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### 3. REQUIREMENTS

3.1 Qualification. MIL-S-22885 shall apply except that the switch assemblies shall have passed the tests specified in section 4 of this specification. Samples shall be as specified in section 4 of this specification.

3.2 Detailed requirements for individual types. MIL-S-22885 shall apply except that switch assemblies covered by this specification shall conform to the applicable specification sheets.

3.3 Materials. MIL-S-22885 shall apply. Finishes as specified in MIL-S-22885 shall apply except as specified in the applicable specification sheets. Polyurethane elastomeric materials shall be in accordance with requirements 17 and 47 of MIL-STD-454.

3.4 Design and construction. MIL-S-22885 shall apply except as follows. Lamps rated at 28 volts shall be supplied by the vendor. In interlocked switch assemblies, only mechanical interlocking shall be used. All portions of switch assemblies below the mounting flanges shall be within the maximum mounting flange dimension. Minimal cross sectional area shall be a design goal. The switches used in the switch assemblies shall be in accordance with MS 24547-1.

3.4.1 Lens color. The color shall be aviation red or aviation green as defined by FED-STD-3. Lens color shall be in accordance with the applicable specification sheets.

3.4.2 Luminance. MIL-S-22885 shall apply except as follows. The luminance of each switch that utilizes green filters shall be greater than 100 foot-lamberts when the switch is illuminated by two lamps (one lamp for switch assemblies C/N 252839-1 and C/N 252839-16) at rated voltage. The average brightness of each switch that utilizes red filters shall be uniform and of the same nominal value to within 25 percent of nominal when illuminated by two lamps (one lamp for switch assemblies C/N 252839-2, C/N 252839-8, C/N 252839-17, C/N 252839-18 and C/N 252839-19) at one-half rated voltage. The brightness shall be as specified when the switch assemblies are not mechanically actuated.

3.4.3 Weight. The weight shall be as specified on the applicable specification sheets.

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3.4.4 Touch temperature. The touch temperature shall not exceed 113° F under conditions of 80° F ambient temperature (still air) for 30 minutes at sea level with no forced cooling air. The touch temperature shall be defined as on the surface of the cap where the switch must be pressed to be actuated. The touch temperature specified shall not be exceeded under the combined effects of the following conditions:

- a. Normal panel mounting as shown on Drawing 3111475 under operational conditions of the aircraft
- b. Switch not mechanically actuated, with two lamps illuminated at rated voltage (+28 volts) and with green filters installed (except C/N 252839-1 and C/N 252839-16, which shall be illuminated by one lamp).
- c. Producing luminance of 100 foot-lamberts minimum (in the green illuminated condition).

3.4.5 Modular construction. A design objective of the switch assemblies shall be to utilize nonrepairable modules for ease of maintenance and accessibility.

3.4.6 Size. The size of the switch assemblies shall conform to the applicable specification sheets.

3.4.7 Interference. The switches shall be designed to minimize radiation and/or conduction from the device and to minimize susceptibility of the device to EMI. The switch assembly caps shall have separate ground paths for EMI shielding.

The switches shall be installed in a system which shall be tested per MIL-STD-461 and MIL-STD-462 for class ID equipment.

3.4.8 Detent position. In all switch assemblies, the travel from the deactuated position to the mechanical stop position shall be 0.15 inch minimum. The distance between mechanically actuated (detent) positions and deactuated positions of the switch caps shall be as follows:

- a. 0.09 inch minimum - mechanical alternate switch assemblies.
- b. 0.15 inch minimum - mechanically interlocked switch assemblies.

3.4.9 Operating force. The operating force of the switch assembly shall be 6.0 pounds maximum except for C/N 252839-1, -2, -8, -16, -17, -18 and -19, which may have a maximum operating force of from 1 to 2.5 pounds.

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3.4.10 Interchange. Cap and base assemblies within each switch assembly shall be indexed to prevent unintentional interchange except switch assemblies CN 252839-1, -2, -8, -16, -17, -18 and -19 which shall contain no index provisions. Switch assemblies C/N 252839-3, -4, -12, and -13 shall be indexed to prevent unintentional interchange.

3.4.11 Legend. Unless otherwise specified, the legend on the switch caps shall be reproduced in light characters visible at all times on an opaque black background. Contrast between the lettering and the black background of the pushbuttons shall be 3 or greater. Contrast is defined as :

$$C = \frac{B_2 - B_1}{B_1}$$

where C is the contrast,  $B_1$  is the brightness of the black, and  $B_2$  is the brightness of the lettering. The external illumination for the contrast measurements shall be furnished by uniform, diffused, artificial illumination with the switch integral lighting system deenergized. The background shall be No. 37038 in accordance with FED-STD-595. Legends shall be as shown on the applicable specification sheets. When illuminated, legends shall show colors specified herein. The lettering of legends shall be from 0.125 to 0.141 inch in height and of the type shown on the applicable specification sheets. The following code is used on the specification sheets to identify the type of lettering:

- a. "A" - Alternate or Gorton Gothic 3, stroke width 0.020 to 0.025
- b. "B" - Alternate or Gorton Gothic 2, stroke width 0.020 to 0.025

3.4.12 Light leakage. With lamps of a given switch module illuminated, no light shall emanate from adjacent switch modules.

3.4.13 Lubricants. Greases or other compounds which can rub off or deteriorate with use shall not be used on the switch assemblies.

3.5 Performance. MIL-S-22885 shall apply with the following exceptions.

#### 3.5.1 Vibration

3.5.1.1 Vibration operating. There shall be no opening or closing of switch contacts in excess of 10 microseconds, and there shall be no visual indications of light intermittency during exposure to

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the random vibration shown in figure 1 applied separately to each of three orthogonal directions at the mounting points for a period of 3.2 hours. The center frequencies  $fc_1$ ,  $fc_2$  and  $fc_3$  shown in figure 1 vary such that equal time is spent in any octave or fraction of an octave. The switch assembly shall meet the above requirements when the mounting point is subjected to random vibration with a constant acceleration spectral density of  $0.024 \text{ g}^2 / \text{cps}$  between 20 and 2000 cps for a period of 3.2 hours in each of three orthogonal directions.

3.5.1.2 Gunfire vibration. There shall be no opening or closing of switch contacts in excess of 10 microseconds, and there shall be no visual indications of light intermittency during exposure to the vibration conditions shown in figure 2 applied at the mounting point for a period of 10 minutes within each range of gunfire rates in each of three orthogonal directions. Figure 2 presents the sinusoidal components of a complex periodic vibration with periodicity equal to the gunfire rate. Within each range of gunfire rates, all possible gunfire rates are assumed to be equally likely.

3.5.1.3 Vibration - nonoperating. The switch assemblies shall be capable of withstanding sinusoidal acceleration in the frequency range of 1.5 to 30 cps limited to  $\pm 0.5g$ . The switch assemblies shall operate satisfactorily after being subjected to swept sinusoidal vibration in the frequency range of 5 to 2000 cps. The vibration acceleration shall be limited to the lesser of 0.5 inch double amplitude or  $\pm 2g$  at attachment points.

3.5.2 Shock. The switch assemblies shall meet the shock requirements of MIL-E-5400 except that for mounting base (crash safety) the requirements of 3.5.2.2 shall apply.

3.5.2.1 Shock - nonoperating. The switch assemblies shall operate satisfactorily after being subjected to two shocks applied to each orthogonal axis. The shock shall have a half sine waveform of 25g maximum acceleration and a time duration of 3.0 plus or minus 0.5 milliseconds.

3.5.2.2 Crash landing loads. (ultimate load factor). Switch mounting provisions shall have sufficient strength to withstand a longitudinal load factor of 40, acting individually, in all forward azimuths within 20 degrees from the longitudinal axis. The switch assembly shall not become detached from its mounting and shall not be required to function after being subjected to the crash landing loads.

3.5.3 Seal. The watertight and dripproof seals of MIL-S-22885 shall not apply.

3.5.4 Color filters. Color filters shall be in accordance with the applicable specification sheets.

3.5.5 Barriers. Barriers shall be as shown on the applicable specification sheets.

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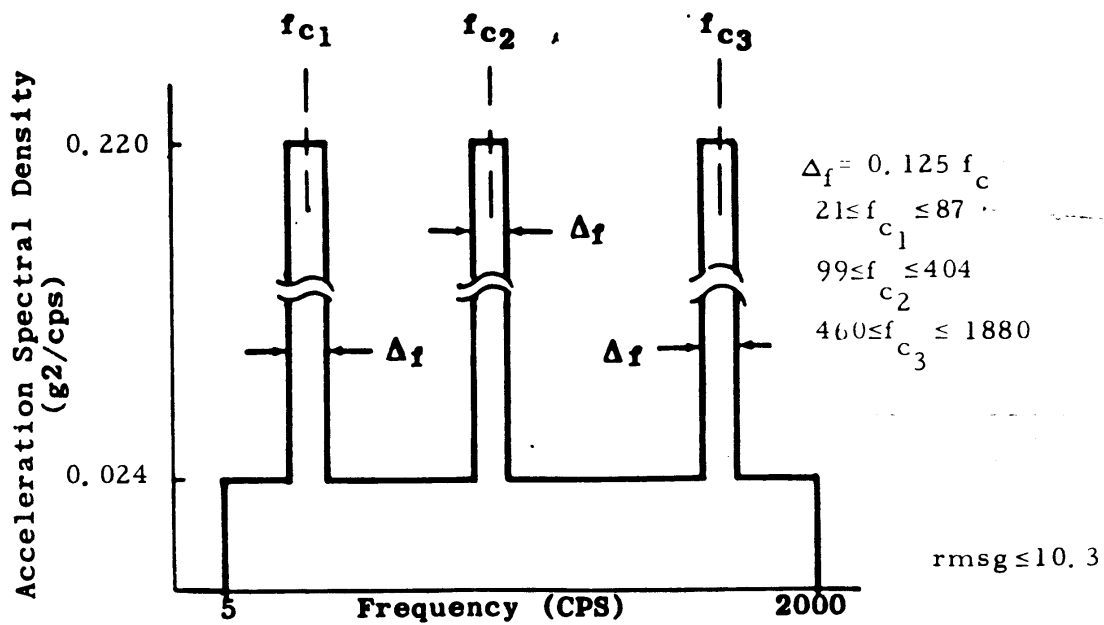


Figure 1. Acceleration Spectral Density.

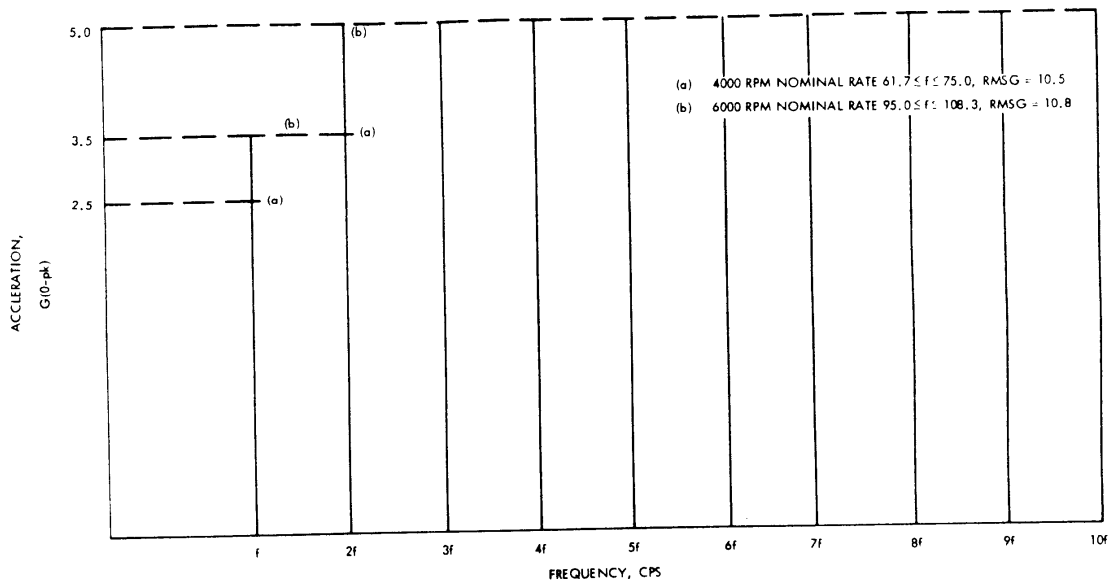


Figure 2. Gunfire Vibration Spectrum

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3.5.6 Panel seals. MIL-S-22885 shall not apply.

3.5.7 Temperature - altitude. In lieu of the requirements of MIL-E-5400 for temperature, altitude, and temperature-altitude combination for equipment installed in the cockpit, the following shall apply. The switch assemblies shall operate under the conditions of the temperature-altitude combination shown in figure 3. The switch assemblies in a nonoperating condition shall withstand ambient temperature in the range of minus 80 to plus 203°F. In addition, the switch assemblies shall have warmup capability from temperatures of minus 65 to plus 160°F, within 5 minutes. The switch assemblies shall be capable of withstanding decompression from sea level pressure to aircraft ambient pressure in 0.5 second after which the equipment shall provide specified performance for 10 minutes at a maximum pressure altitude for class 2 equipment. In addition, no deformation or disintegration of equipment shall occur which could cause injury to a crew member or jeopardize aircraft safety when the cockpit decompresses explosively from cockpit pressure to aircraft ambient pressure within 0.01 second.

3.5.8 Fungus. The switch assemblies shall withstand exposure to fungus growth as encountered in tropical climates.

3.6 Reliability. Each switch of each switch assembly shall have a mean-cycle-between failures (MCBF) of 280,000 cycles or more when operated under the environmental conditions specified herein.

3.7 Marking. MIL-S-22885 shall apply except that the HAC control number shall be used in lieu of the specification sheet part number. In addition, base assemblies shall be identified by the HAC control number in parentheses, vendor part number, terminal identification, station location, and date code (year/week). Cap assemblies shall be identified by the vendor part number.

3.8 Workmanship. MIL-S-22885 shall apply.

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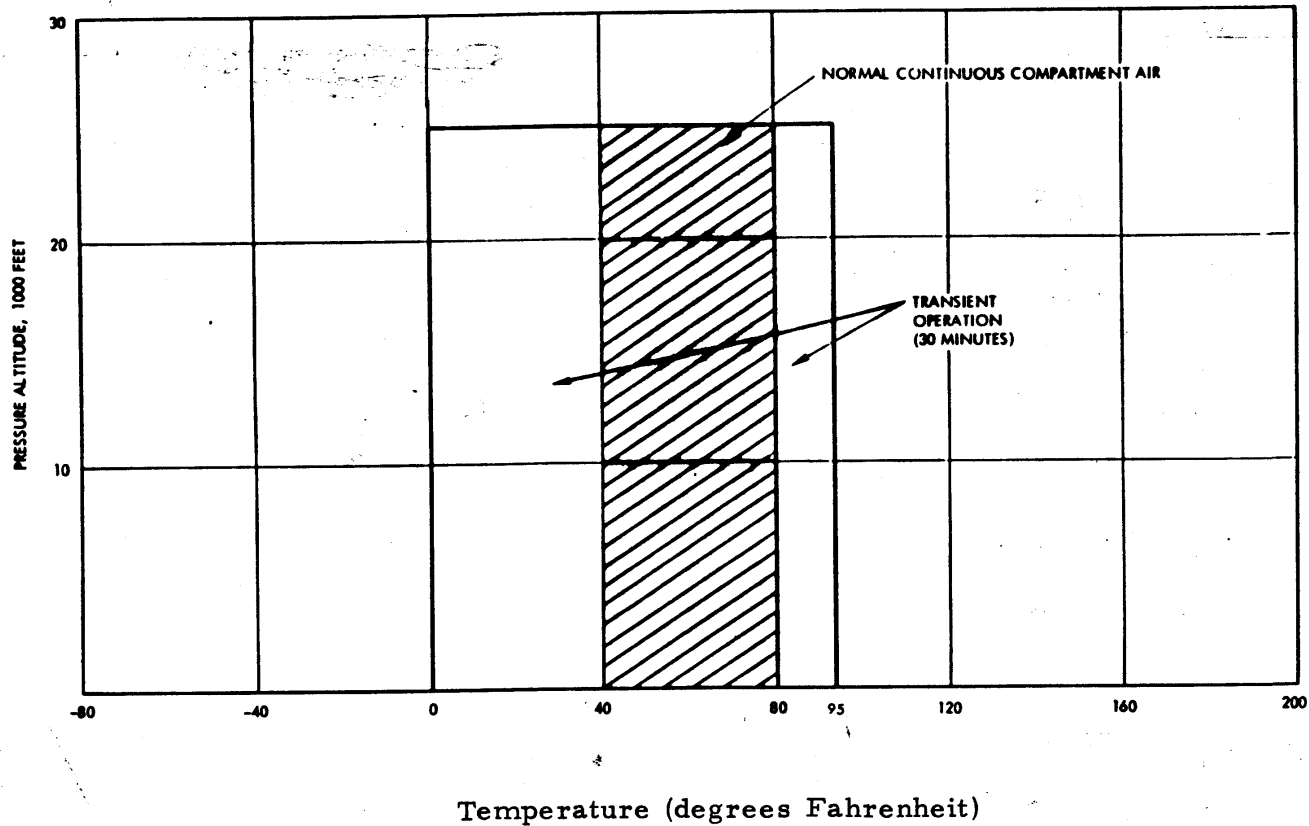


Figure 3. Cockpit Temperature-Altitude Operating Requirements.

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#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. The supplier is responsible for the performance of the tests specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial facilities acceptable to HAC. Where tests are necessary to assure supplies and services conform to prescribed requirements, HAC reserves the right to perform any of the tests in this specification.

4.2 Classification of tests. The examination and testing of switch assemblies shall be classified as follows:

- a. Component materials tests
- b. Qualification tests
- c. Acceptance tests

4.3 Component materials inspection. Component materials tests shall consist of certification that the component materials listed in table I, used in fabricating the switches, are in accordance with the applicable referenced specifications or requirements prior to such fabrication.

4.4 Test conditions. Unless otherwise specified herein, all tests shall be conducted under the following conditions:

- a. Room ambient temperature (60 to 90°F)
- b. Normal ground altitude
- c. Room ambient relative humidity (45 to 75 percent)
- d. Switch assembly mounted as shown in figure 4.

4.5 Qualification tests. Qualification tests shall be conducted at a laboratory satisfactory to Hughes Aircraft Company. Qualification tests shall consist of the following and shall be in accordance to MIL-E-5400 unless otherwise specified herein.

- a. Contrast
- b. Luminance
- c. Touch temperature
- d. Temperature/altitude
- e. Vibration
- f. Shock

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TABLE I  
COMPONENT MATERIALS TESTS

Item	Component material	Requirement	Applicable specification
1.0	Plastic material		
1.1	Thermosetting	MIL-S-22885	MIL-M-14
1.2	Thermoplastics	MIL-S-22885	L-P-410, MIL-M-20693* or FED-STD- 406 (Method 2021. 1)
2.0	Finish:		
2.1	Anodized aluminum	MIL-S-22885	MIL-A-8625
2.2	Chemical treatment for aluminum	MIL-S-22885	MIL-C-5541
2.3	Color lamp filters	MIL-S-22885	ZZ-R-765** or MIL-F-21241
<p>Notes:</p> <p>*MIL-S-22885 applies MIL-P-17091, which has been cancelled and superseded by L-P-410 and MIL-M-20693.</p> <p>**MIL-S-22885 applies MIL-R-5847, which has been cancelled and superseded by ZZ-R-765.</p>			

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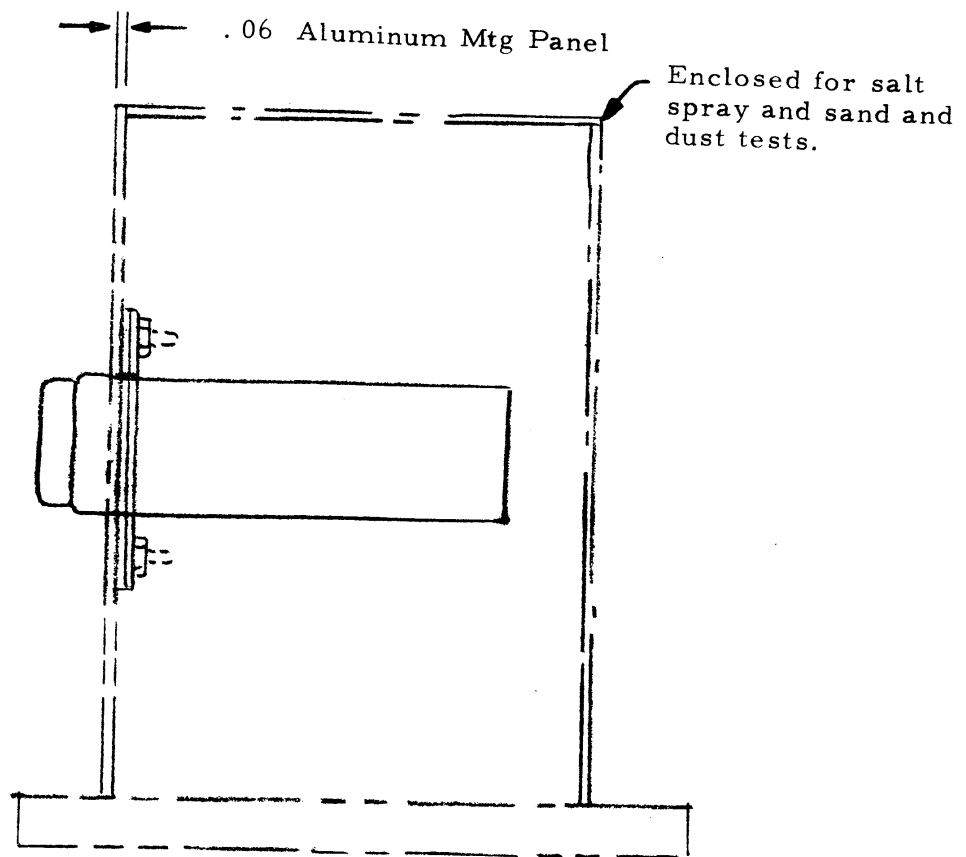


Figure 4 Test Mounting Structure

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4.5 (continued)

- g. Dielectric withstanding voltage
- h. Insulation resistance
- i. Contact resistance
- j. Electrical endurance
- k. Salt spray
- l. Sand and dust
- m. Moisture resistance
- n. Humidity

4.5.1 Samples for qualification tests. One sample of each of the switch assemblies C/N 252839-1, -3, -6, and -9 shall receive qualification tests of 4.5 (a) through (n).

4.5.2 Luminance and contrast. The average of three readings of luminance shall meet the requirements of 3.4.2. The three readings shall be taken at different locations on the switch cap to ensure an evenness of lighting as specified herein. All measurements shall be made in such a way that the axis of the brightness meter is perpendicular to the surface being measured. The brightness meter shall be calibrated. All measurements shall be made in completely dark surroundings. The average of three pairs of readings of contrast shall meet the requirements of 3.4.11. The three readings shall be taken at different locations on the switch cap. The following equipment is capable of performing the tests specified:

- a. Brightness meter: Spectra Spot Brightness Meter, manufactured by Photo Research Corporation, Hollywood, California.

4.5.3 Touch temperature. The touch temperature shall be measured when the switch assembly is illuminated by two lamps at rated voltage and with green filters installed, except that C/N 252839-1, -2, -8, -16, -17, -18 and -19 shall be illuminated by one lamp. In the modular switch assemblies, only the middle switch shall be illuminated. With the ambient temperature 80°F and with no forced air circulation or detectable draft near the switch assembly, the lamp shall be energized for 30 minutes. The temperature on the surface where the switch is pressed to be actuated shall not exceed 113°F when measured by thermocouples or

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equivalent calibrated temperature sensors. The thermocouples must be in actual pressure contact with the switch cap, and isolated from other heat or cooling sources during measurements.

4.5.4 Temperature - altitude. The switch assemblies shall be placed in a test chamber and subjected to the temperature - altitude combinations of 3.5.7. Switching characteristics shall be in accordance with MIL-S-22885 during operation under conditions listed below. The lamp load shall be through the contacts of the switch assembly, and shall consist of make or break cycles at a rate of 10 to 12 cycles per minute. The length of time for each combination shall be as follows:

- |                                |            |
|--------------------------------|------------|
| a. 10,000 feet (+30 to -65°F)  | 30 minutes |
| b. 10,000 feet (-65°F)         | 5 minutes  |
| c. 25,000 feet (+30 to +160°F) | 30 minutes |
| d. 25,000 feet (160°F)         | 5 minutes  |

4.5.5 Vibration. Vibration tests shall be performed in accordance with method 204, test condition A. of MIL-STD-202, except that the limits shall be from 5 to 2000 cps and return to 5 cps. The method of measurement during vibration shall be in accordance with 3.5.2.

4.5.6 Shock. Shock test shall be performed in accordance with method I of MIL-S-22885 except that the limits shall be in accordance with MIL-S-22885.

4.5.7 Dielectric withstanding voltage. The dielectric withstanding voltage tests shall be in accordance with MIL-S-22885 on one sample of each type of switch assembly C/N 252839-1 thru -22. The reduced barometer pressure test shall be conducted at 60,000 feet.

4.5.8 Insulation resistance. The insulation resistance test shall be tested in accordance with MIL-S-22885.

4.5.9 Moisture resistance. The moisture resistance test of MIL-S-22885 shall apply.

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4.5.10 Electrical endurance. The switch assemblies shall be tested for electrical endurance in accordance with MIL-S-22885 and table II on one sample of each type of switch assembly. The loads used shall be as specified in 4.5.4.

TABLE II  
ELECTRICAL ENDURANCE TESTS

Item	Switch Assembly C/N	Switch Assembly Stations to be Actuated	Altitude	
			Sea level	60,000 ft.
1	252839-1 and -16	Two End Buttons	X	
2	252839-2, -17 and -19	A and P	X	
3	252839-7 and -15	A and H	X	
4	252839-9, -11 and -21	A and D	X	X
5	252839-3 and -4		X	
6	252839-12 and -13		X	

4.6 Acceptance tests. The following acceptance tests shall be performed on every switch assembly.

- a. Examination in accordance with MIL-S-22885
- b. Switching characteristic in accordance with MIL-S-22885
- c. Lamp circuit in accordance with MIL-S-22885.

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4.6 (Continued)

- d. Operating force in accordance with MIL-S-22885 and 3.4.9 herein
- e. Detent position in accordance with 3.4.8 herein.

4.7 Rejection and retest. Failure to pass any of the tests specified herein shall be cause for rejection. The failed switch assemblies will be returned to the vendor for rework and/or redesign, and subsequently retested until successful completion of all tests. The cost of any rework or redesign and retest by the vendor shall be borne by the vendor under the original cost proposal.

5. PREPARATION FOR DELIVERY

5.1 Preservation, packagaing, and packing. Preservation, packaging, and packing procedures shall comply with Interstate Commerce Commission rules and regulations and shall assure arrival at destination in acceptable condition. The ability of the equipment to satisfy the requirements of section 3 herein shall not be degraded.

5.2 Marking for shipment. In addition to any special marking required by the contract, marking for shipment shall be in accordance with MIL-STD-129.

6. NOTES

6.1 General. The notes of MIL-S-22885 shall apply.

6.2 Marginal indicia. The margins of this specification and the specification sheets are marked with a vertical bar to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and Hughes Aircraft Company assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notation and relationship to the last previous issue.

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REVISIONS					
EFF	AUTHORITY	SYM	DESCRIPTION	DATE	APPROVED
	ECA 188849-5  ECR 509427	D	This page added Inc. EO 87194  Inc. EO 85475	3 DEC 71	<i>[Signature]</i>
	ECA 185252-1 185250-1 ECR 592135 592156 655603 643021	E	INC EO 58630 INC EO 58570  INC EO 59440 INC EO 59497 INC EO 22352 SEE REV NOTICE	28 FEB 75	<i>G. Pantano</i>

PS 31046-165